



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

PATENT

Applicant : Nancy K. Del Grande Docket No. : ND-1
Serial No. : 10/769,217 Art Unit: 2884
Filed : January 30, 2004 Examiner: Boosalis, F.
For : Thermal Imaging Method to Detect Subsurface Objects

DECLARATION UNDER 37 CFR §1.132

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

I, Nancy K. Del Grande, hereby declare that I am a citizen of the United States of America and a resident of Newark, California.

I obtained a MS in physics from Stanford University in 1957 and an A.B. in physics from Mount Holyoke College in 1955.

I worked for Lawrence Livermore National Laboratory for 41 years as a physicist in the fields of nuclear, atomic, x-ray, infrared and thermal physics.

I have worked for Geo-Temp Corporation for 21 years in the field of applied physics and detection of subsurface objects by thermal imaging.

I have read the office action and would like the examiner to consider my comments concerning the rejection of claims 1-4, 7, 8 and 14-20 as being unpatentable over Prelat et al. in view of Torgersen et al. and Sunlin et al.

Prelat et al. is inapplicable to my claimed method. The method of the reference has limitations preventing interpretation of heat flows from naturally-heated materials, objects or structures at depths deeper than two (2) meters, at least for the following reasons:

1. Prelat does not use two (2) co-registered, thermal-infrared wavebands centered near 5 microns and 10 microns, to correct apparent-temperature images with (2–4) degree K errors from emissivity, reflectance and/or geochemical effects. These errors mask heat flow anomalies from subsurface objects. See the attached document, which is incorporated by reference into the application and is cited as: LeSchack and Del Grande, Geophysics, Vol. 41, No. 6, pp. 1319-21 and 1335-36, December 1976. See also Del Grande et al. (U.S. Patent No. 5,444,241, also incorporated into the application).
2. Prelat uses only diurnal solar heating to locate apparent heat flows from objects less than the diurnal solar heat-penetration depth, 50 cm, in dry soil. Del Grande in the present application uses annual solar heating to locate heat flows from objects less than the annual solar heat-penetration depth, 10 m, in dry soil.
3. Prelat does not refer to an equilibrium temperature simulator model for calculating survey times and environments when surface temperatures and surface temperature spreads exceed 0.5 degrees K to distinguish a subsurface object (or structural flaw) site from an ambient (undisturbed) host site as described in LeSchack and Del Grande (1976), Vol 41, No. 6, pp.1325-26, December 1976. My discussion uses 0.5 degrees K because state-of the art

instrumentation can distinguish temperature spreads that differ by at least that amount.

4. Prelat does not calculate the undisturbed host-site thermal inertia compared to a suspect subsurface object- site thermal inertia. These calculations, based on the square root of the product of thermal conductivity, density and heat capacity for the object- site relative to the host-site, help determine thickness, volume and depth information for characterizing the subsurface object.

Torgersen et al. and Sunlin et al. are also inapplicable. Torgersen uses a dual-band thermal infrared scanner for water assessment in rivers and streams. Sunlin uses a radar-penetration method to produce a three-dimensional (3D) image of an underground target area. It is not true that either of these methods enables one experienced in airborne remote sensing to image 0.5 degrees K true-temperature anomalies from deep, underground objects at least for the following reasons:

1. Unlike water, terrain covered by sand, topsoil, rocks or concrete does not have a gray-body or blackbody radiating surface that is insensitive to infrared emissivity, reflectance and geochemical absorption anomalies for common silicate and carbonate anion groups.
2. Unlike water, concrete slabs viewed at mid-afternoon (14:50 hrs) and predawn (06:02 hrs) had non-thermal spectral differences with apparent temperatures of 2 degrees K or less in the (8–12) micron thermal-IR band compared to the (3–5) micron thermal-IR band.

3. To image ground temperatures, the Power Law thermal model uses dual-band thermal-infrared ratios to enhance temperature patterns and remove (2–4) degrees K temperature errors from emissivity, reflectance and/or geochemical effects. See LeSchack and Del Grande, *Geophysics*, Vol. 41, No. 6, pp. 1319-1321, 1335-1336, Dec. 1976.
4. The radar penetration method of Sunlin et al., unlike the thermal method of the present invention, is not able to be flown from a UAV platform at an altitude of 3 km or to produce clutter-free interpretable images verifiable in the field with thermal probes.
5. Unlike the radar method, 3D maps of above-ambient temperature contrast, temperature spread and inverse thermal inertia provide thickness, volume and depth information for characterizing the subsurface object.
6. Del Grande et al. *SPIE Vol. 3587*, p.189, Feb. 1999 published a 3D map of daytime above-ambient and ambient temperatures for damaged and normal concrete bridge-deck areas, predicting a scalloped -edge fault and a triangular-shaped normal area. A photo taken after removing the pavement confirmed the DBIR thermal map predictions.

Accordingly, I respectfully request that the rejections be withdrawn.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful

false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Respectfully submitted,

A handwritten signature in cursive script, reading "Nancy K. Del Grande".

Nancy K. Del Grande

Dated: July 22, 2006